Listing of Pending Claims

1. (original) A ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \quad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

2. (original) A composition according to claim 1, wherein B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B; and

B″ represents one or a combination of elements selected from the group of Zn, Li, and Mg.

3. (original) A composite material comprising a porous body portion comprising a mixed conducting oxide, and a film portion including a gastight dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein at least one of said porous body portion and said dense continuous layer includes a ceramic composition in perovskite structure

expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1;\ 0 < x;\ 0 < y \leq 0.5;\ 0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

4. (original) A composite material comprising a porous body portion comprising a mixed conducting oxide, and a film portion including a gastight dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein at least one of said porous body portion and said dense continuous layer includes a ceramic composition in perovskite structure expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being in the range of 0% to 10% of the molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

5. (original) An oxygen separator including a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

6. (original) An oxygen separator including a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being in the range of 0% to 10% of the molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1;\ 0 < x;\ 0 < y \leq 0.5;\ 0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

7. (original) A chemical reactor including a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1; 0 < x; 0 < y \leq 0.5; 0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

8. (original) A chemical reactor including a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\} \{B_xB'_yB''_z\} O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being in the range of 0% to 10% of the molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1; 0 < x; 0 < y \leq 0.5; 0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

9. (canceled)

10. (previously presented) A method of producing a composite material, wherein a porous body portion comprising a mixed conducting oxide of claim 1 is sintered at a temperature higher than the sintering temperature for a dense continuous layer of a mixed conducting oxide

formed on said porous body portion.

11. (previously presented) A composite material comprising a porous body portion comprising a mixed conducting oxide of claim 1, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein the sintering temperature for the oxide material of said porous body portion is higher than that for the oxide material of said film portion.

12. (previously presented) A material according to claim 11, wherein the porosity of said porous body portion is within the range of 20% to 80%, and the thickness of said dense continuous layer is within the range of 10 μm to 1mm.

13. (previously presented) A composite material comprising a porous body portion comprising a mixed conducting oxide, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein

said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

14. (previously presented) A composite material comprising a porous body portion comprising a mixed conducting oxide, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

15. (canceled)

16. (previously presented) A composite material with a porous body portion comprising a mixed conducting oxide, and a film portion including a gastight dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein said mixed conducting oxide of said porous body portion is expressed by general formula (2)

$$AFe_xO_{(3-\delta)} \qquad (2)$$

where $0.98 \leq x \leq 1.02$; A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; and δ represents a value which is so determined as to meet charge neutralization conditions and said mixed conducting oxide of said dense continuous layer is of general formula (3)

$$\{Ln_{1-a}A_a\}\ \{B_xB'_y\}\ O_{(3-\delta)} \qquad (3)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Fe and Co;

B' represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 \leq y \leq 0.2$;

$0.98 \leq x + y \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

17. (original) A material according to claim 16, wherein said material is made in a manner that said porous body portion comprising said mixed conducting oxide of claim 1 is sintered at a temperature higher than the sintering temperature for said dense continuous layer of said mixed conducting oxide to be formed on said porous body portion, and then said film portion including said dense continuous layer is formed on said porous body portion.

18. (canceled)

19. (previously presented) A method of producing a composite material the method comprising:

providing a porous body portion including a mixed conducting oxide, said mixed conducting oxide of said porous body portion comprising a mixed conducting oxide expressed by the following general formula (2):

$$AFe_xO_{(3-\delta)} \qquad (2)$$

where $0.98 \leq x \leq 1.02$; A represents one or a combination of elements selected from the group of Bs, Sr, and Ca; and δ represents a value which is so determined as to meet charge neutralization conditions,

subjecting said porous body portion to a heat treatment, the maximum temperature not to exceed 1400°C;

forming a film portion including a gastight continuous layer of a mixed conducting oxide on said porous body portion; and

subjecting said dense continuous layer to a heat treatment, the maximum temperature for which is lower than the maximum temperature for said porous body portion by 20°C or more.

20. (previously presented) A composite material comprising:

a porous body portion comprising a mixed conducting oxide, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions; and wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (3):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_y\}\ O_{(3-\delta)} \qquad (3)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Fe and Co,

B' represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.2$;

$0.98 \leq x + y \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

21. (canceled)

22. (previously presented) A composite material comprising:

a porous body portion comprising a mixed conducting oxide, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and

Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1; 0 < x; 0 < y \leq 0.5; 0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions; and wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (3):

$$\{Ln_{1-a}A_a\} \{B_xB'_y\} O_{(3-\delta)} \qquad (3)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Fe and Co,

B' represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1; 0 < x; 0 < y \leq 0.2;$

$0.98 \leq x + y \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

23. (original) A material according to claim 11, wherein said dense continuous layer is made of a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\} \{B_xB'_yB''_z\} O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions

24. (previously presented) A composite material comprising:

a porous body portion comprising a mixed conducting oxide, and a film portion including a dense continuous layer of a mixed conducting oxide formed on said porous body portion, wherein said porous body portion and said dense continuous layer are made of a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y ~~and~~ <u>of</u> B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

25. (original) A material according to claim 11, wherein said dense continuous layer is made of a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B'' represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions.

26. (presently amended) A material according to claim ~~24~~ 13, wherein said dense continuous layer is made of a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions,

the sum of the molar numbers of Nb and Ta for the dense continuous layer is smaller that that for the porous body.

27. (original) A material according to claim 26, wherein, in said formula (1) expressing said ceramic composition of said dense continuous layer, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, and B″ represents one or a combination of elements selected from the group of Zn, Li, and Mg.

28. (previously presented) A composite material with a dense continuous layer comprising a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1)

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe or Co, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B″ represents one or a combination of elements selected from the group of Cu, Ni, Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions; and

a porous body portion comprising a mixed conducting oxide, said porous body portion is expressed by general formula (2):

$$AFe_xO_{(3-\delta)} \qquad (2)$$

where $0.98 \leq X \leq 1.02$; A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; and δ represents a value which is so determined as to meet charge neutralization conditions.

29. (original) A material according to claim 28, wherein, in said formula (1) expressing said ceramic composition of said dense continuous layer, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe; and B" represents one or a combination of elements selected from the group of Zn, Li, and Mg.

30. (original) A material according to claim 13 or 16, wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (4)

$$\{Ln_{1-x}A_x\}_yCoO_{(3-\delta)} \qquad (4)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids; A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; $0.8 \leq x \leq 1$; $0.98 \leq y \leq 1.02$; and δ represents a value which is so determined as to meet charge neutralization conditions.

31. (original) A material according to claim 13 or 16, wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having itscomposition expressed by the following general formula (5)

$$A\{Co_{1-x}Fe_x\}_yO_{(3-\delta)} \qquad (5)$$

where A represents one or a combination of elements selected from the group of Ba, Sr,

and Ca; $0 \leq x \leq 0.2$; $0.98 \leq y \leq 1.02$; and δ represents a value which is so determined as to meet charge neutralization conditions.

32. (original) A material according to claim 13 or 16, wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (6):

$$A\{Co_xFe_yB_z\}O_{(3-\delta)} \qquad (6)$$

where A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; B represents one or a combination of elements selected from the group of Cu, Ni, and Zn; $0 \leq x$; $0 \leq y$; $0 < z \leq 0.2$; $0.98 \leq x + y + z \leq 1.02$; and δ represents a value which is so determined as to meet charge neutralization conditions.

33. (previously presented) A material according to claim 13, wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (7):

$$A\{Co_xFe_yB_z\}O_{(3-\delta)} \qquad (7)$$

where A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; B represents one or a combination of elements selected from the group of Nb and Ta; $0 \leq x$; $0 \leq y$; $0 < z \leq 0.2$; $0.98 \leq x + y + z \leq 1.02$; and δ represents a value which is so determined as to meet charge neutralization conditions.

34. (previously presented) A material according to claim 13, wherein said dense continuous layer is made of a ceramic of a mixed conducting oxide having its composition expressed by the following general formula (8):

$$A\{Co_xFe_yB_zB'_{z'}\}O_{(3-\delta)} \qquad (8)$$

where A represents one or a combination of elements selected from the group of Ba, Sr, and Ca; B represents one or a combination of elements selected from the group of Nb and Ta; B' represents one or a combination of elements selected from the group of Cu, Ni, and Zn; $0 \leq x$; $0 \leq y$; $0 < z \leq 0.2$; $0 \leq z' \leq 0.2$; $0.98 \leq x + y + z + z' \leq 1.02$; and δ represents a value which is so determined as to meet charge neutralization conditions.

35. (previously presented) A composite material comprising an oxygen exchange layer disposed on one side or two sides of an oxide having oxide ion diffusivity and porosity from 20% to 80%, wherein said oxygen exchange layer comprises an oxide expressed by

$La_uSr_{b-u}Fe_vCo_{c-v}O_{3-w}$,

wherein $0.1 \leq u < 0.5$, $0.9 < b < 1.1$, $0 < v < 1.1$, and $0.9 < c < 1.1$., and is of different oxide composition than said oxide having oxide ion diffusivity.

36. (original) A material according to claim 35, wherein said oxygen exchange layer comprises a dense film, a porous body, or island-shaped discontinuous films whose average thickness is 30 μm or less.

37. (original) A material according to claim 35, wherein said oxide having oxide ion diffusivity is formed into a thin film whose thickness is 300 μm or less.

38. (canceled)

39. (previously presented) A material according to claim 3, 4 or 16, wherein an oxygen exchange layer is formed on a surface of one or either side of said dense continuous layer, said oxygen exchange layer being made of an oxide of different composition than the oxide forming said dense continuous layer.

40. (previously presented) A material according of claims 3, 4 or 16, wherein the porosity of said porous body portion is within the range of 20% to 80%, and the thickness of said dense continuous layer is within the range of 10 μm to 1mm.

41. (previously presented) A method of making a composite material for the separation of oxygen from a mixed gas, comprising: providing a sintered, porous body portion comprising a mixed conducting oxide, wherein said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and Ga, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions; and

forming a sintered film portion including a gastight dense continuous layer of a mixed conducting oxide on said porous body portion, wherein the maximum sintering temperature for said mixed conducting oxide of porous body portion is greater than the maximum sintering temperature for said dense continuous layer.

42. (previously presented) A method of making a composite material for use as a chemical reactor, comprising: providing a sintered, porous body portion comprising a mixed conducting oxide, wherein said porous body portion comprises a ceramic composition as a mixed conducting oxide in perovskite structure, said composition being expressed by the following general formula (1):

$$\{Ln_{1-a}A_a\}\ \{B_xB'_yB''_z\}\ O_{(3-\delta)} \qquad (1)$$

where Ln represents one or a combination of elements selected from the group of Y and lanthanoids;

A represents one or a combination of elements selected from the group of Ba, Sr, and Ca;

B represents one or a combination of elements selected from the group of Co, Fe, Cr, and

Ga, B always containing Fe, the molar number of Co being within the range of 0% to 10% of the total molar number of Fe, the sum of the molar numbers of Cr and Ga being within the range of 0% to 20% of the total molar number x of B;

B' represents one or a combination of elements selected from the group of Nb, Ta, Ti, and Zr, B' always containing Nb or Ta, the sum of the molar numbers of Ti and Zr being within the range of 0% to 20% of the total molar number y of B';

B" represents one or a combination of elements selected from the group of Zn, Li, and Mg;

$0.8 \leq a \leq 1$; $0 < x$; $0 < y \leq 0.5$; $0 \leq z \leq 0.2$

$0.98 \leq x + y + z \leq 1.02$; and

δ represents a value which is so determined as to meet charge neutralization conditions; and

forming a sintered film portion including a gastight dense continuous layer of a mixed conducting oxide on said porous body portion, wherein the maximum sintering temperature for said mixed conducting oxide of porous body portion is greater than the maximum sintering temperature for said dense continuous layer.